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Preface

This report describes a navigation channel reliability monitoring and evaluation study conducted at Willapa Bay, Washington, by the U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), Vicksburg, MS, for the U.S. Army Engineer District, Seattle (NWS). The study was established under a Partnering Agreement between the NWS and the Willapa Port Commission to investigate the feasibility of maintaining a reliable navigation channel through the entrance to Willapa Bay. Funding authority was provided by NWS to CHL on 6 April 1998, and a review draft of this report was submitted to NWS on 21 December 1998. Mr. Hiram T. Arden was the NWS point of contact for this study, with technical assistance and review of this report provided by Messrs. Arden, Eric E. Nelson, and Robert M. Parry, NWS.

The ERDC study team was under the technical direction of Dr. Nicholas C. Kraus, Coastal Sediments and Engineering Division (CSED), CHL, and task-area leaders were Dr. Adele Militello, Navigation and Harbors Division (NHD), CHL, for Long Waves, Sedimentation and Salinity; Dr. Jane M. Smith, Coastal Processes Branch (CPB), CSED, for Short Waves; Mr. William C. Seabergh, Harbors and Entrances Branch (HEB), NHD, for Engineering; Mr. Edward B. Hands, Coastal Evaluation and Design Branch (CEDB), CSED, for Morphology, Mr. Michael W. Tubman, Prototype Measurement and Analysis Branch (PMAB), CSED, for Field Data Collection Contract Management and Data Management; and Mr. Larry E. Parson, CEDB, CSED, for SHOALS Surveying.

Significant technical assistance in conducting the study was provided by Dr. S. Rao Vemulakonda, Estuaries, Bays and Lagoons Group, Tidal Hydraulics Branch (THB), Estuaries and Hydroscience Division (EHD), CHL, and Dr. Joon P. Rhee, PMAB, CSED. Additional technical support at CHL was provided by Ms. Mary Claire Allison, Dr. Andrew Morang, and Mr. Michael Martinez, CEDB, CSED, Mr. Fulton Carson, CPB, CSED, and Ms. Leonette J. Thomas, HEB, NHD. Secretarial and clerical support was provided by Ms. Janie G. Daughtry and Ms. J. Holley Messing, CEDB, CSED, and Ms. Myra E. Willis, HEB.

Assistance at NWS was provided by Mses. Elizabeth W. Bachtel and Joyce E. Rolstad at the NWS archive; Messrs. Denny S. Mahar and Lonnie M. Reid in surveying and cartographic control; and Mr. Thomas G. Landreth, captain of the survey vessel *Shoalhunter*. Field studies were conducted under contract with Evans-Hamilton, Inc. (EHI), led by Mr. Keith Kurrus, EHI. Portions of the field study analysis were subcontracted by EHI to Pacific

International Engineering[PLLC] (PIE). Mr. Harry Hosey and Dr. Vladimir Shepsis were the study leaders for PIE.

This study was conducted during the period April 1999 through June 1999 under the general supervision of Dr. James R. Houston, Director of CHL, respectively: Mr. Thomas W. Richardson, Chief of CSED; Mr. William H. McAnally, Chief of EHD; Mr. Bruce A. Ebersole, Chief of CPB; Ms. Joan Pope, Chief of CEDB; Mr. Robert T. McAdory, Chief of THB; Mr. Willam L. Preslan, Chief of PMAB; and Mr. Dennis G. Markle, Chief of HEB.

This study benefited from discussions and coordination meetings involving representatives from or staff members of the following organizations: Messrs. Gerald J. Heintz and James Neva, Port of Willapa; Mr. Randy Lewis, City of West Port; Mr. Jeff Cox, EHI; and Messrs. Hosey, Hugo Bermudez, Scott Fenical, David Simpson, and Nels Sultan, and Dr. Shepsis, PIE.

Contributors to this report are identified on the first page of each chapter. Dr. Kraus was the report technical editor. Mr. Markle was also assistant to Dr. Kraus and served as administrative point of contact for this study.

At the time of publication of this report, Dr. Lewis E. Link was Acting Director of ERDC, and COL Robin R. Cababa, EN, was Commander.

Conversion Factors Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.028317	cubic meters
cubic yards	0.7645549	cubic meters
feet	0.3048	meters
miles (U.S. nautical)	1.852	kilometers
miles (U.S. statute)	1.609347	kilometers
tons (long, 2,240 lb mass)	1,016.047	kilograms